FIG. 1

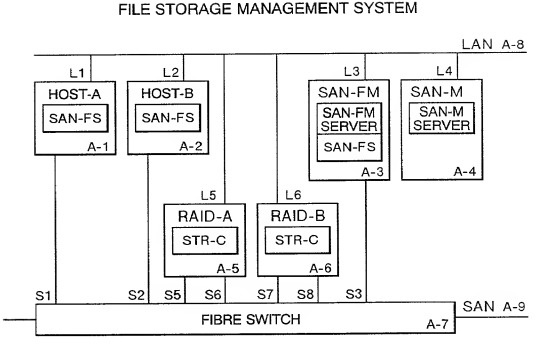

FILE STORAGE MANAGEMENT SYSTEM
LAN A-8
L1
L2
L3
L4
HOST-A
SAN-FS
A-1
HOST-B
SAN-FS
A-2
SAN-FM
SAN-FM SERVER
SAN-FS
A-3
SAN-M
SAN-M SERVER
A-4
L5
L6
RAID-A
STR-C
A-5
RAID-B
STR-C
A-6
S1
S2
S5
S6
S7
S8
S3
SAN A-9
FIBRE SWITCH
A-7

FIG. 2

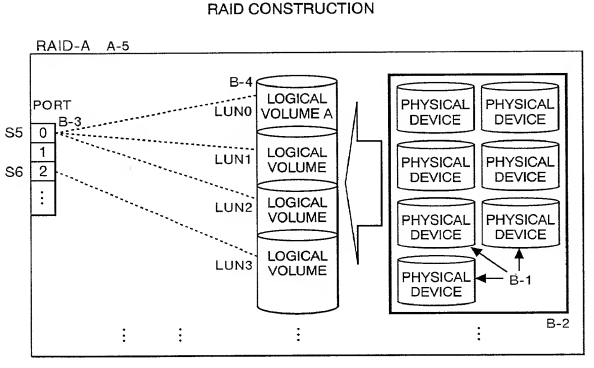

RAID CONSTRUCTION
RAID-A A-5
PORT
B-3
S5
0
1
S6
2
B-4
LUN0
LOGICAL VOLUME A
LUN1
LOGICAL VOLUME
LUN2
LOGICAL VOLUME
LUN3
LOGICAL VOLUME
PHYSICAL DEVICE
B-1
B-2

FIG. 3

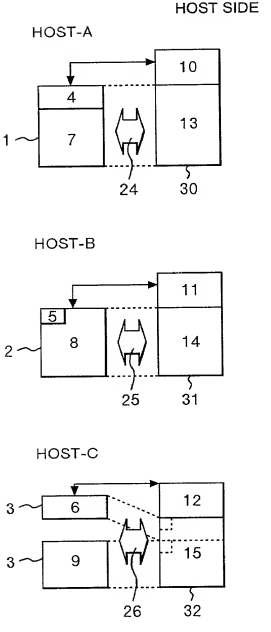

HOST SIDE
HOST-A
10
4
1
7
13
24
30
HOST-B
11
5
2
8
14
25
31
HOST-C
3
6
12
3
9
15
26
32

FIG. 4

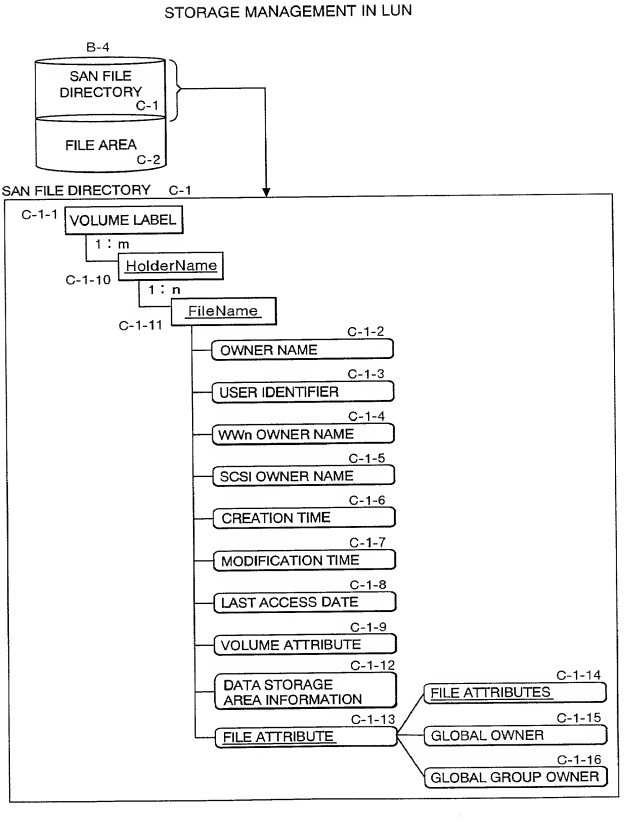

STORAGE MANAGEMENT IN LUN
B-4
SAN FILE DIRECTORY C-1
FILE AREA C-2
SAN FILE DIRECTORY C-1
C-1-1
VOLUME LABEL
1 : m
HolderName
C-1-10
1 : n
FileName
C-1-11
C-1-2
OWNER NAME
C-1-3
USER IDENTIFIER
C-1-4
WWn OWNER NAME
C-1-5
SCSI OWNER NAME
C-1-6
CREATION TIME
C-1-7
MODIFICATION TIME
C-1-8
LAST ACCESS DATE
C-1-9
VOLUME ATTRIBUTE
C-1-12
DATA STORAGE AREA INFORMATION
C-1-13
FILE ATTRIBUTE
C-1-14
FILE ATTRIBUTES
C-1-15
GLOBAL OWNER
C-1-16
GLOBAL GROUP OWNER

FIG. 5

STORAGE MANAGEMENT IN LUN

D-1

SAN FILE DIRECTORY (SAN-FD)

FileName	DATA STORAGE AREA INFORMATION	FILE ATTRIBUTE	VOLUME LABEL	OWNER NAME	USER IDENTIFIER	WWn OWNER	SCSI OWNER
CREATION TIME	MODIFICATION TIME	LAST ACCESS DATE	VOLUME ATTRIBUTE	HolderName			
sssssssss	hhhhhhh	RRRRR	VOL1	TTTT	QQQQQ	0101000000	I1T2L3
xxxxxxxh	xxxxxxxxxk	xxxxxxxxxxl	FFFFFFFF	Holder-A			
sssssssssa	hhhhhha	RRRRA	VOL1	TTTA	QQQQA	0101000001	I1T2L4
xxxxxxxq	xxxxxxxxxe	xxxxxxxxxxr	FFFFFFFQ	Holder-B			
:							

FIG. 6

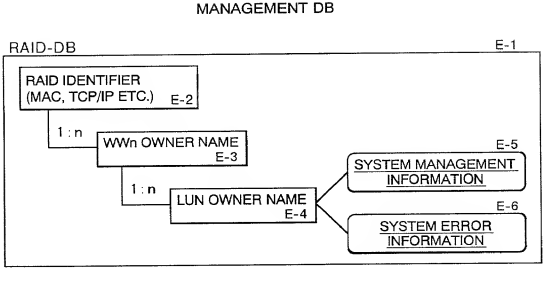

MANAGEMENT DB
RAID-DB
E-1
RAID IDENTIFIER
(MAC, TCP/IP ETC.)
E-2
1 : n
WWn OWNER NAME
E-3
1 : n
LUN OWNER NAME
E-4
E-5
SYSTEM MANAGEMENT INFORMATION
E-6
SYSTEM ERROR INFORMATION

FIG. 7

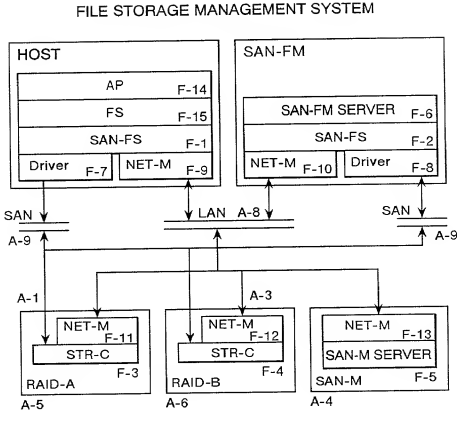

FILE STORAGE MANAGEMENT SYSTEM
HOST
AP
F-14
FS
F-15
SAN-FS
F-1
Driver
F-7
NET-M
F-9
SAN-FM
SAN-FM SERVER
F-6
SAN-FS
F-2
NET-M
F-10
Driver
F-8
SAN
A-9
LAN
A-8
SAN
A-9
A-1
A-3
NET-M
F-11
STR-C
F-3
RAID-A
A-5
NET-M
F-12
STR-C
F-4
RAID-B
A-6
NET-M
F-13
SAN-M SERVER
SAN-M
F-5
A-4

FIG. 8

FILE CONVERSION FLOW

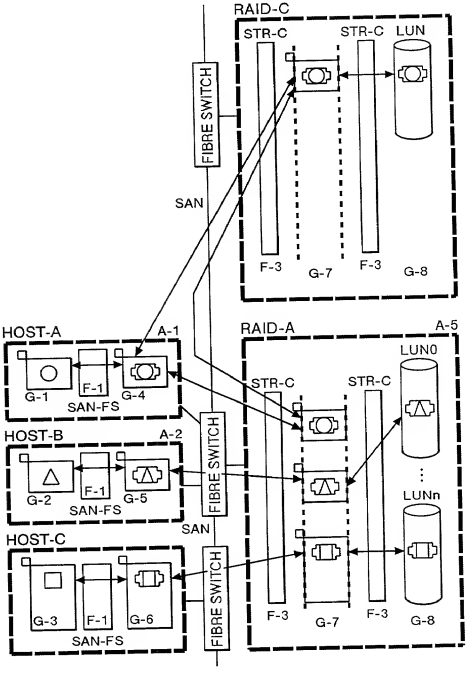


FIG. 9

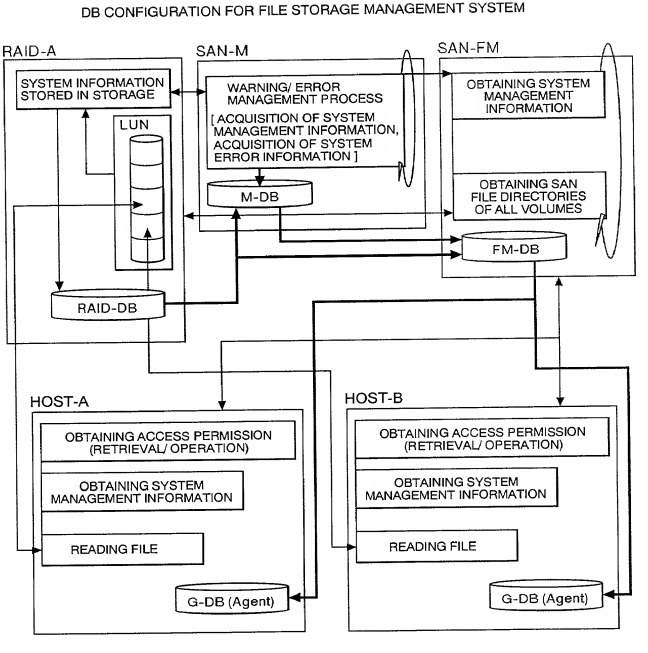

DB CONFIGURATION FOR FILE STORAGE MANAGEMENT SYSTEM
RAID-A
SYSTEM INFORMATION STORED IN STORAGE
LUN
RAID-DB
SAN-M
WARNING/ ERROR MANAGEMENT PROCESS
[ACQUISITION OF SYSTEM MANAGEMENT INFORMATION, ACQUISITION OF SYSTEM ERROR INFORMATION]
M-DB
SAN-FM
OBTAINING SYSTEM MANAGEMENT INFORMATION
OBTAINING SAN FILE DIRECTORIES OF ALL VOLUMES
FM-DB
HOST-A
OBTAINING ACCESS PERMISSION (RETRIEVAL/ OPERATION)
OBTAINING SYSTEM MANAGEMENT INFORMATION
READING FILE
G-DB (Agent)
HOST-B
OBTAINING ACCESS PERMISSION (RETRIEVAL/ OPERATION)
OBTAINING SYSTEM MANAGEMENT INFORMATION
READING FILE
G-DB (Agent)

FIG. 10

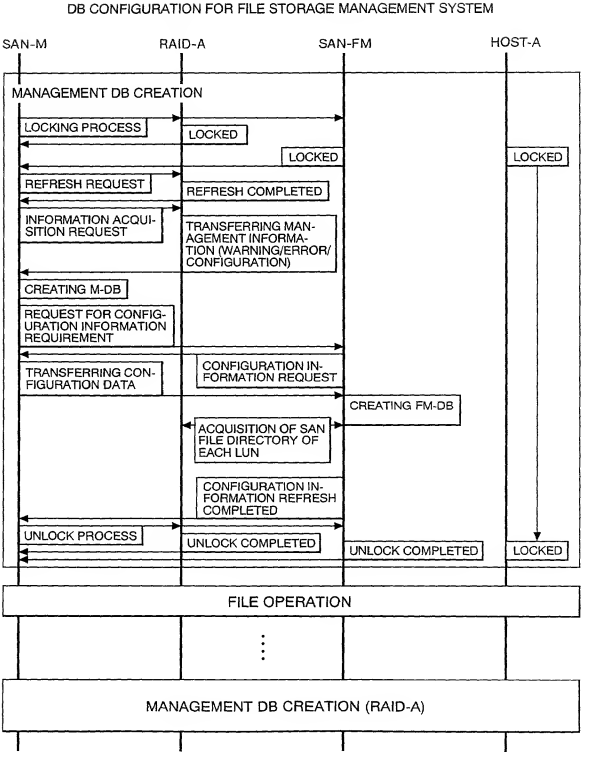

DB CONFIGURATION FOR FILE STORAGE MANAGEMENT SYSTEM
SAN-M
RAID-A
SAN-FM
HOST-A
MANAGEMENT DB CREATION
LOCKING PROCESS
LOCKED
LOCKED
LOCKED
REFRESH REQUEST
REFRESH COMPLETED
INFORMATION ACQUISITION REQUEST
TRANSFERRING MANAGEMENT INFORMATION (WARNING/ERROR/CONFIGURATION)
CREATING M-DB
REQUEST FOR CONFIGURATION INFORMATION REQUIREMENT
TRANSFERRING CONFIGURATION DATA
CONFIGURATION INFORMATION REQUEST
CREATING FM-DB
ACQUISITION OF SAN FILE DIRECTORY OF EACH LUN
CONFIGURATION INFORMATION REFRESH COMPLETED
UNLOCK PROCESS
UNLOCK COMPLETED
UNLOCK COMPLETED
LOCKED
FILE OPERATION
MANAGEMENT DB CREATION (RAID-A)

FIG. 11

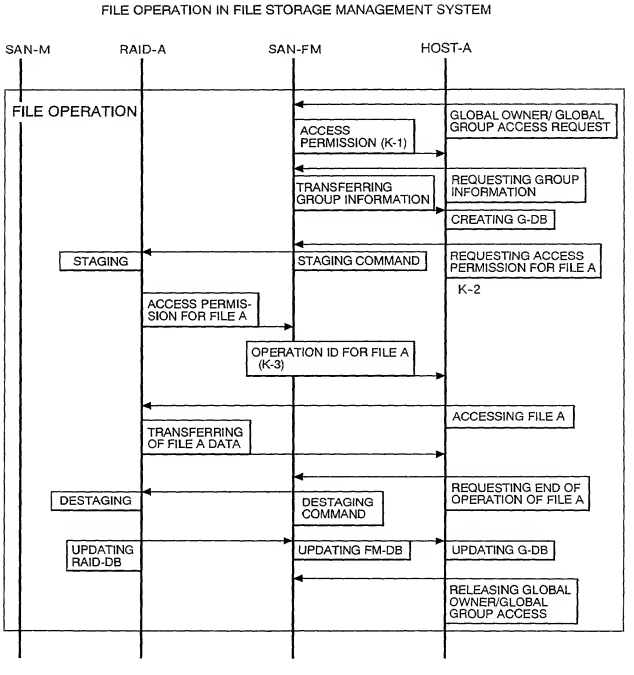

FILE OPERATION IN FILE STORAGE MANAGEMENT SYSTEM
SAN-M
RAID-A
SAN-FM
HOST-A
FILE OPERATION
GLOBAL OWNER/ GLOBAL GROUP ACCESS REQUEST
ACCESS PERMISSION (K-1)
TRANSFERRING GROUP INFORMATION
REQUESTING GROUP INFORMATION
CREATING G-DB
STAGING
STAGING COMMAND
REQUESTING ACCESS PERMISSION FOR FILE A
K-2
ACCESS PERMIS-SION FOR FILE A
OPERATION ID FOR FILE A (K-3)
ACCESSING FILE A
TRANSFERRING OF FILE A DATA
DESTAGING
DESTAGING COMMAND
REQUESTING END OF OPERATION OF FILE A
UPDATING RAID-DB
UPDATING FM-DB
UPDATING G-DB
RELEASING GLOBAL OWNER/GLOBAL GROUP ACCESS

FIG. 12

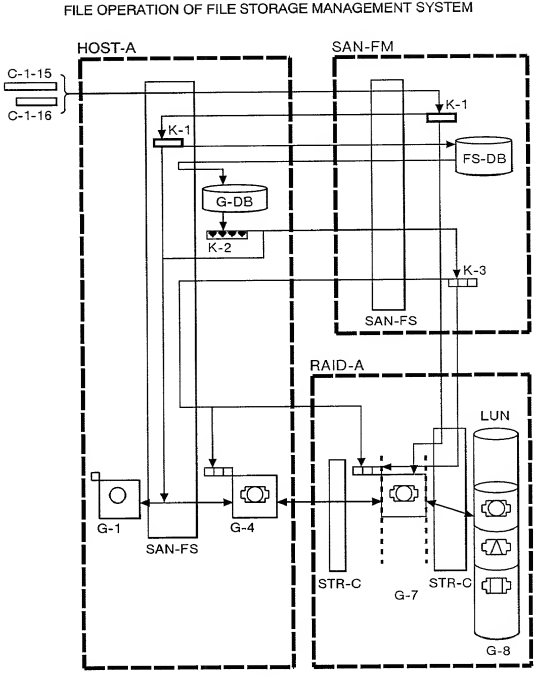

FILE OPERATION OF FILE STORAGE MANAGEMENT SYSTEM
HOST-A
SAN-FM
C-1-15
C-1-16
K-1
K-1
FS-DB
G-DB
K-2
K-3
SAN-FS
RAID-A
LUN
G-1
SAN-FS
G-4
STR-C
G-7
STR-C
G-8

FIG. 13

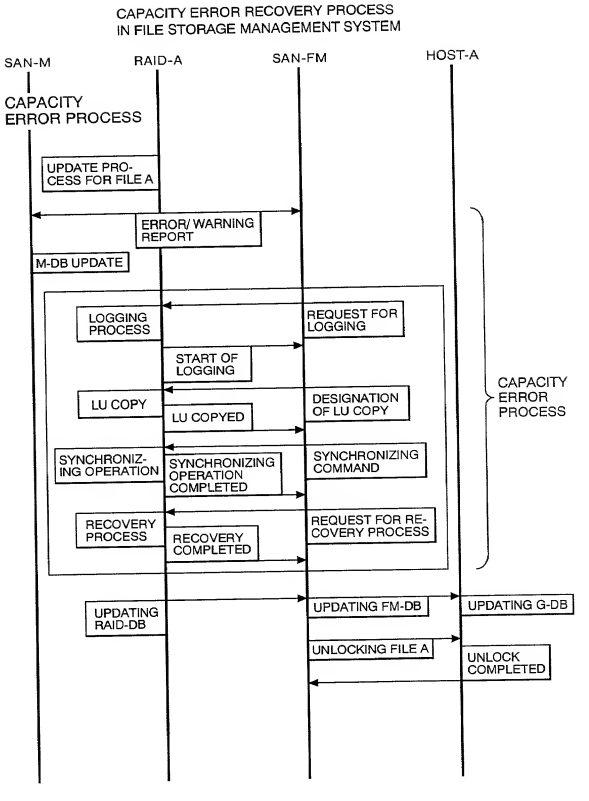
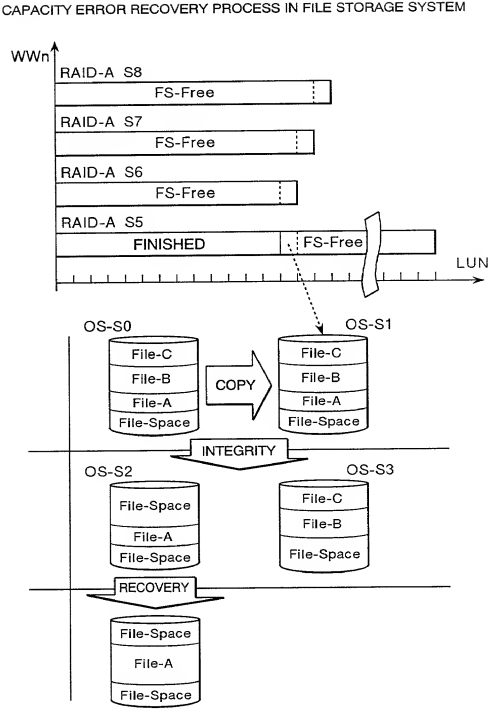

CAPACITY ERROR RECOVERY PROCESS
IN FILE STORAGE MANAGEMENT SYSTEM
SAN-M
RAID-A
SAN-FM
HOST-A
CAPACITY ERROR PROCESS
UPDATE PRO-CESS FOR FILE A
ERROR/ WARNING REPORT
M-DB UPDATE
LOGGING PROCESS
REQUEST FOR LOGGING
START OF LOGGING
LU COPY
LU COPYED
DESIGNATION OF LU COPY
CAPACITY ERROR PROCESS
SYNCHRONIZ-ING OPERATION
SYNCHRONIZING OPERATION COMPLETED
SYNCHRONIZING COMMAND
RECOVERY PROCESS
RECOVERY COMPLETED
REQUEST FOR RE-COVERY PROCESS
UPDATING RAID-DB
UPDATING FM-DB
UPDATING G-DB
UNLOCKING FILE A
UNLOCK COMPLETED

FIG. 14


CAPACITY ERROR RECOVERY PROCESS IN FILE STORAGE SYSTEM
WWn
RAID-A S8
FS-Free
RAID-A S7
FS-Free
RAID-A S6
FS-Free
RAID-A S5
FINISHED
FS-Free
LUN
OS-S0
File-C
File-B
File-A
File-Space
COPY
OS-S1
File-C
File-B
File-A
File-Space
INTEGRITY
OS-S2
File-Space
File-A
File-Space
OS-S3
File-C
File-B
File-Space
RECOVERY
File-Space
File-A
File-Space